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BRIEFLY TOLD.

THE GAS COAL CARRYING TRADE.—During the closing days of November, all of December, and, we might say, so far this month, many of the Eastern and Middle State Gas Companies have been clamoring for more frequent deliveries of gas coal under current contracts, and, without looking backward a trifle, in the effort to determine whether they were not fairly chargeable themselves with a good part of the blame for the scarcity of coal in their sheds, seem to be unanimous in declaring that the managements of the gas coal companies are either inadequate to the carrying on of their business, or else are indifferent to the demands of their customers. It might be well to hesitate over thus roundly placing the blame burden on the shoulders of the gas coal producers, or their other selves, the gas coal carriers, for it seems to us that many a complaining gas company of to-day took it rather easily in the matter of requiring a fair percentage of the deliveries under the contracts to be made, say in August, September and October. In that quarter the railroads and boatmen were not driven to their wit's end to find cars or boats wherewith to transport the various materials and matter that were offered them, nor can it be said that the storage sheds of the gas companies were bursting from the heaps of gas coal that had been received by them, in partial delivery under the year's contracts. September and October, particularly the first-named month, was a fairly open one for the railroads, and did the clamoring gas companies of to-day then have but thought of the morrow both they and the gas coal miners would now be indulging in mutual congratulations over the comfortable appearance of the situation. Each could insure to the other such comfort, were both to observe the fair spirit of deliveries and receipts under a contract for so many tons to be taken up in a twelvemonth; but there must be confusion when all the receivers unite in making their demands upon the deliverers for perhaps 60 per cent. of the total tons to be shipped in about 15 per cent. of the total time length of the contract. The companies, too, put the fault bluntly upon the mine owners, whereas the latter have the coal broken out and ready for shipment at the pits, but are unable to move it from the sparsity of the car equipment at the railroads—an equipment, however, that would be up to the demands were the latter made in deference to the safe practice that protects those who do not seek to secure everything all at once. There should be more give and take in this matter of coal deliveries and receipts; and after one has looked the case over fairly and fully, the real wonder is that the mine owners have been able to do as well as they have done.

THE PHILADELPHIA GAS COAL CONTRACTS.—The bids for supplies to the Philadelphia Municipal Gas Works for the ensuing year having been opened and the awards having been pretty nearly all made, it may interest our readers to learn how the allotment in respect of gas coal was fixed by Director Windrim, who, it is our pleasant duty to add, has made quite a good name for himself in the direction of this generally unique municipal enterprise. Although the specifications called for the supply of 235,000 tons of ordinary coking coal for the ensuing year, it will be seen from the appended table detailing the separate awards made that only 208,000 tons will be received this year; and the authorities explain this cutting down over the original estimate by the statement that, at the prices and quantities submitted and allotted, the amount of money appropriated by Councils on this account had been absorbed. Under this ruling we must take it for granted that the works' engineers will be short something like 17 per cent. in the quantity of coal needed by them to meet the gas demands of the city for the year, unless they are willing to admit that they cannot estimate within that per cent. of what their needs will be in this particular direction. However, we would and do incline to the belief that the works' engineers are likely to be nearer the mark in that regard than either Director Windrim or the City Council. There is, no doubt, a saving clause for the gas consumers in the fact that the city can buy a larger percentage of water gas from the contractors, who are attending to that branch of the municipal gas enterprise—a purchase that will in

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all probability be recorded before '93 fades into '94. The names of the successful bidders, the quantities allotted and the prices are appended:

Name of Bidder.	Gross Quantity in Tons.	Price Per Ton.
Penn Gas Coal Co.	59,000	$3 71
Westmoreland Gas Coal Co.	59,000	3 71
Manor Gas Coal Co.	5,000	3 69
C. B. Orcutt	25,000	3 69
Montana Coal and Coke Co.	15,000	3 67
Despard Coal Co.	15,000	3 67
Newburgh Orrel Coal and Coke Co.	15,000	3 67
Gaston Coal Co.	15,000	3 67

Messrs. J. & W. Wood were authorized to deliver 5,176 tons of cannel at $6.05 per ton.

DEATH OF MR. F. H. ODIORNE.—On November 1st, 1892, occurred the death of Mr. Austin M. Copp, of the firm of F. H. Odiorne & Co., the well known gas coal factors, of Boston, Mass., and this week we are called upon to chronicle the death of Mr. F. H. Odiorne, the senior member of the firm, who answered the death summons on the morning of the 3d inst. Strangely enough, Mr. Odiorne's death occurred from a cause similar to that to which his partner succumbed—an affection of the heart. Mr. Frederick Hussey Odiorne, who was born at Malden, Mass., on April 26, 1830, was a son of Thomas and Mary Odiorne, the former of whom was a descendant of one of the pioneers who founded the settlement that resulted in the present city of Portsmouth, N. H. Deceased received his education in the public school of his native town, and on entering his business career, took a subordinate position in the Malden counting room of the store of Thomas Tremlett. In 1856 he went west to engage with his brother (under the firm name of Odiorne & Bro.) in the commission business in Cincinnati, O. This was not a particularly successful alliance, for in 1857 we find him in Boston, Mass., as a member of the house of Tremlett & Odiorne, which engaged his attention (from 1860 until 1872 he carried on that venture alone) until 1872, when the enterprise admitted of a partnership enlargement—it was in 1872 when the late Mr. A. M. Copp joined hands as partner with deceased—and the firm became known as F. H. Odiorne & Co. Their principal business, which was the wholesale distribution of coal, largely on commission lines, was very successful. The concern did a large trade with the gas companies of the East, and this connection eventually placed him in direct financial touch with several companies of that section. He was President of the Gloucester, Mass., and the Plymouth, Mass., Gas Light Companies, and ex-President of the Rockland (Me.) Gas Company, and was also a Director in the Brookline and the Citizens (Quincy) Gas Light Companies, of Massachusetts. He was elected to active membership in the American Gas Light Association at the 1875 meeting, and was also an associate member of the Guild of Gas Managers. He was interested in a great many other business enterprises in the East, and his associates paid great heed to his advice, which reliance was well founded, if we may judge from the results that he and they obtained from ventures of mutual interest. He was a member of the Boston Coal Club, the Middlesex Club and the Malden Board of Trade, and was prominent in the Masonic circles of the State. The only public office held by him in Malden was that of Alderman at-Large, but it is also a fact that political preferment had many times been refused by him. We might in this connection add that it is largely to his efforts that Malden owes its present excellent system of public water supply. His wife, formerly Miss Adeline Robertson, to whom he was married in 1854, survives him. Deceased was a man of sterling integrity, and of undoubted good business perception.

NOTES.—It is with great satisfaction that we announce the return, to the firm of Messrs. P. H. & F. M. Roots, of Mr. D. T. Roots, formerly President of the Company. He will, at the annual meeting of the Company, to be held in February next, be re-elected President, an office that he formerly filled with credit to himself and with profit to the Company.——The proprietors of the Brooklyn Clay Retort and Fire Brick Works (Messrs. E. D. White & Co.) have given notice that the firm has been dissolved by mutual consent, and that the Company is now in liquidation. Thus ends the career of a firm that was always characterized by honorable, straightforward dealing; and Messrs. Edward D. White and Ira N. Stanley carry with them to their retirement from active business in this line the heartiest good wishes of everyone who ever had dealings with them.——The Brookline (Mass.) Gas Light Company has declared a dividend of $3 per share, payable on the 16th inst.——Mr. T. W. Cole, after 13 years of painstaking and successful work as Superintendent of the Altoona (Pa.) Gas Company, has resigned that position.

An Unpopular Subject, Popularly Treated *

By MR. FREDERIC EGNER.

The sum of human ignorance in relation to common things is in nothing greater than about illuminating gas—notwithstanding that it has become with many a necessity, is at least one of the conveniences of life, and that in its manufacture and distribution tens of millions of dollars and hundreds of people are employed in this city (St. Louis) alone. To which may be added that the smoke nuisance, so frequently complained of and so earnestly sought to be abated, could be practically obliterated by a sensible, more extended use of gas for all purposes where coal is now erroneously supposed to be indispensable.

"A reduction in the price of gas has been announced by the gas company; but we have no doubt but what the meter will do its duty and attend to it that dividends are not impaired. As it is rumored that an application of pneumatic tires to the gas meters is one of the improvements contemplated, rejoicings had better be postponed."

That is a sample of the nonsense presented to readers of our daily papers, at times when, as we imagine, there is a dearth of news. Would it not be more desirable to readers and creditable to publishers to print instructive information upon a subject of such importance to nearly all the people, rather than meaningless, though misleading, squibs. I propose in this article to give a brief recapitulation of the history of gas lighting in St. Louis and an elucidation of the principles or elements of the industry in general.

True, the art of making and distributing gas for light, heat and power cannot be detailed in a newspaper article. Hundreds of volumes have been devoted to the subject, and yet, to the well informed, the industry seems still to be in its infancy. The story is told of a well known and able lawyer of this city, who at one time sent his son (now also a successful lawyer of acknowledged ability) to the gas works, with which he was officially connected, to study the gas business. The then very young man spent two or three hours there, and returning informed his father that he now knew all about it. The elder gentleman did not know much about it himself—though at that time I believe he was Vice-President of the company; but he knew the thing was not quite as simple as that. So he requested the son to go back, telling him not to return until he was sure he thoroughly understood the business. This time the young man tarried two days, and then declared that he absolutely understood it all. Upon this the parent remarked that the boy was evidently too smart to become a gas man, and so made a lawyer of him instead.

This anecdote illustrates the apparent simplicity of the matter to the superficial or self-conceited inquirer. And this same apparent simplicity, coupled with genuine ignorance of the principles involved, is the fruitful cause of the numerous alleged inventions and supposed improvements in an industry, an approximately thorough knowledge of which is possessed by comparatively few, and which cannot be obtained except by hard work and years of practical experience. But the half-taught inventor keeps on, aided and enabled by an overcrowded, hence not too careful Patent Office and a prejudiced public, to unload the products of his fertile brain on progressive, but sometimes only greedy and unscrupulous capitalists or promotors, so called, to the detriment of all mankind, especially those residing in cities.

Although the art of gas making is more complicated than it seems at first, the elements composing it are simple enough; and a knowledge of and careful consideration of these will serve to not only guard the inexperienced from loss, but may direct the thoughtful mind into channels leading to the further improvement of manufacture and application, and hence, usefulness, of this unpopular article, through means of which, however, so much has been added to the comfort of mankind.

The honor and merit of the first application of coal gas to useful purposes are beyond question due to William Murdoch, who, in 1797, lighted his own premises, and a year later a large factory. So we read in "King's Treatise on Coal Gas," a standard work upon the subject. Gas was first introduced in this country by David Melville, at Newport, Rhode Island, in 1806, who took out a patent for his invention in 1813. The first regular gas company was organized at London, England, in 1808; and Baltimore, Md., was the first (1813) American city to have a gas works. The first works in St. Louis were erected, I believe, in 1844; the Company was chartered in 1839. This was the St. Louis Gas Light Company, and, following the practice in vogue for many years, charged as much per thousand cubic feet of gas as it could get. In 1872, when the Laclede Gas Light Company's works were built at the foot of Howard street, gas was selling in the city, if I remember aright, at

* Prepared by the author for a St. Louis daily newspaper.

$4.50 per thousand; but after the Laclede Company commenced to sell gas the price was reduced to $2.50, which, in 1883, was still further reduced by the latter Company to $1.50, and again, in the greater part of its district, to $1 per thousand cubic feet. The old St. Louis Gas Light Company continued to charge $2.50 per thousand cubic feet almost to the very last year of its existence as a Company. So that, during nearly six years, people residing on the south side of Washington avenue were obliged to pay $2.50, whereas the people on the north side of the same street paid but $1 to $1.50 per thousand cubic feet for the gas used. In 1882 a third gas company, known as the "Water Gas Company," commenced to do business, confining its operations to that portion of the city lying north of Washington avenue. This Company sold gas at $1 per 1,000 cubic feet; and it was stated by those who were in position to know that the cost of each 1,000 cubic feet of gas delivered was several cents higher than the sum received for it. That was principally due to excessive leakage in the underground mains and pipes, caused by hasty and careless work at the beginning of its career.

During the latter part of 1889 the stock of the Laclede Gas Company came into the control of other parties. During 1890 the old St. Louis and the Water Gas Company were absorbed by the Laclede, so that at this time we have but one Gas Company at St. Louis, and gas is sold at $1.18¾ per 1,000 cubic feet; less than is charged for a like quantity at Chicago or New York. The quality of the gas at St. Louis is fixed by law at 18 candle power. Its real quality is usually an average of 20 candles; but as the city has grown so rapidly, the gas mains in many instances are unable at present to supply the full demand at the busiest hours of the night; hence a lack of proper supply is sometimes charged to lack of quality. In any case, if the people do not get the light they want, they charge the trouble to bad gas—no matter if quality or quantity be the fault.

The materials of which gas is made are coal of all varieties, oil—mainly petroleum derivatives—water and air.

Coal gas is made from bituminous or coking coals, put into air-tight retorts, heated externally. During the process of extracting gas from coal, air must be carefully excluded, because if air were admitted the product of the material placed in the retorts would not be gas, tar and coke, but smoke, ashes and soot, in proportion to the amount of air taken in. Another of the principal objections to the mixing of air with illuminating gas is that it rapidly decreases the illuminating power. The following table will show the loss of light by mixing air with coal gas:

	Loss of Light.
1 per cent. air	6 per cent.
2 "	11 "
3 "	18 "
4 "	26 "
5 "	33 "
6 "	44 "
7 "	53 "
8 "	58 "
9 "	64 "
10 "	67 "
15 "	80 "
20 "	93 "
30 "	98 "
40 "	100 "

Besides this, mixtures of air and gas in certain proportions are highly explosive. Advantage of this fact is taken in the gas engine; and this should dispose of the ridiculous charge sometimes made that a gas company is pumping air into its mains.

The introduction of electricity for lighting purposes has educated people to want a brighter light, and plain coal gas, giving an illuminating power of from 14 to 17 standard candles, must now be enriched to give from 18 to 30 candle power for each 5 cubic feet consumed per hour.

And here I will introduce another table, showing the loss of light by using glass shades:

Nature of Globe.	Loss of Light.
Clear glass	10.57 per cent.
Ground glass	29.48 "
Smooth opal	52.83 "
Ground opal	55.85 "
Fancy colored	73.98 "

Comment between the difference in practice followed in incandescent electric lighting (where the clearest of glass is used for the lamps, aided with reflecting shades) and gas lighting (where we frequently see more than half the light obscured by milk glass globes) seems unnecessary.

The enriching of coal gas is accomplished by mixing with it gas from cannels or oil, or very rich so-called water gas. The latter is the most desirable method for large works, and is that followed at St. Louis. The honor and merit of successfully introducing water gas in this country, from where it spread to Europe (where it had been originally invented, tried and abandoned) is due to Colonel, better known as Professor, T. S. C. Lowe, now residing at Los Angeles, Cal. The Professor met with opposition and all kinds of obstacles in his early attempts to introduce water gas, and his reward seems not at all commensurate with his deserts.

Water gas is made by bringing a deep mass of anthracite coal or coke, in a suitable converter, to incandescence by means of an air blast—and it may be noted right here that the only safe and economical purpose for which air may be used in gas making is as a supporter of combustion and a cheap cooling agent; as a diluent, economically considered, it is a failure. This is one of the maxims of practical gas engineering, established by thorough scientific tests. Then all air is shut off and steam forced through the hot coal, when both are decomposed, the oxygen of the steam combining with the carbon from the coal to form carbonic oxide (a combustible gas), and hydrogen is set free. The mixture is uncarbureted water gas. This is odorless, burning with a non-luminous flame, but intense heat.

When it is desired to use this gas for an illuminating agent, either by itself or to enrich coal gas, it must be carbureted, as it is called; which is effected generally by means of some form of crude petroleum or its derivatives. One process of making water gas, known as the Allen and Harris process, accomplishes the same thing by using only rich cannels for the purpose. That process has found little appreciation, however, mainly because it is not properly pushed by its inventors and promoters. In carbureting water gas by means of any oil, much depends upon the apparatus and skill of operater employed as to quantity of oil required; but 4½ gallons per 1,000 cubic feet of say, 22 or higher candle power gas, is a reasonable average. Water gas is also made without using any other fuel than oil. In such apparatus, a lot of checker-brick work, within a suitable vessel, is heated by, first, burning oil, and then steam and oil are injected, and decomposition takes place as before mentioned—only that the carbon of the oil takes the place of that of coal. Very good gas can be made that way, but its cost would seem rather high as compared with the coal process. Still other considerations enter into these calculations which may turn the scale in favor of such a process, but I cannot enter upon them in this article.

We sometimes hear of inventions by means of which 1,000 cubic feet of 22, or higher, candle power gas are said to be produced with an expenditure of not over, and sometimes much less than, 3 gallons of oil and a lot of air. As the air costs nothing, the promoters urge their dupes that thus gas can be very cheaply produced—naturally, if it were true. When, however, such a statement is analyzed the deception or fraud is easily exposed. Three gallons of petroleum yield about 213 cubic feet of 67-candle power gas, to which we could not add more than 38 per cent., or about 80.9 cubic feet of air, without reducing the illuminating power of the mixture to 22 candle power, and no sort of manipulation can add to this result.

Interested promoters sometimes convince ignorant investors that they can produce something out of nothing. In the gas business this deception is usually accomplished by means of a little instrument known as the "Jones Jet Photometer." With it there is little difficulty in making 12 candle power gas appear to be any power which the height and graduations of the chimney admit. If in such cases investors were but to exercise ordinary prudence, and before risking their money consult some reputable gas engineer, the expense attached to such a course would be but a trifle compared with either the possible loss to be borne or the great gain expected.

In the following table (see next page) will be found the per cent. of the various gases now used for light or heat. These vary a little, of course, according as the gas may be taken from one or another locality, or may be richer or poorer in quality; but it is a fair average.

Commercial gas has not been employed for boiler firing because of its price; but gas made on the premises of large manufacturing establishments has been successfully applied, and economy claimed in its use, for all purposes for which other fuel was formerly used. There are failures on record in this direction, too; but they can always be traced back to inexperience or ignorance of the gas business on the part of those who failed. Like the investors previously mentioned, the parties interested hardly, if ever, called an experienced gas engineer to advise them; for it was all so very simple, you know. Twenty cubic feet of the ordinary commercial gas sold everywhere may be relied upon as giving 1 horse power per hour, when used in any good gas engine. One

	Natural Gas. About 10-Candle Power.	Siemens Producer Gas. No Illuminating Power.	Water Gas. 22 Candle Power.	Coal Gas. About 16½-Candle Power.
Oxygen	.80	.00	.06	.00
Hydrogen	22.00	6.00	37.20	46.00
Marsh gas	67.00	3.00	18.18	39.50
Carbonic oxide	.60	23.60	28.26	7.50
Illuminants	6.00	.00	12.82	5.80
Carbonic acid	.60	1.50	.84	.70
Nitrogen	5.00	65.90	2.64	.50
	100.00	100.00	100.00	100.00
Weight per 1,000 cu. ft., in pounds, about	38.2	69.9	40.7	35.28
Heat units per cu. ft., about	789.00	114.00	650.00	674.00

pound of coal converted into gas in a suitable apparatus, and this gas converted into power through a good gas engine, will be guaranteed by some makers to return 1-horse power per hour.

The convenience of gas for cooking and heating purposes cannot be questioned. For the latter it is still too high in price for ordinary use, but for cooking, especially summer work, there is not any fuel which can compare with it in point of cheapness. The writer has satisfied himself that gas for cooking purposes is cheaper at $2.50 per 1,000 cubic feet than pine wood at $3 per cord. It also offers a solution of the "servant girl question" to small housekeepers; for, with the use of gas, much of the drudgery of housework is done away with.

A few words more as to the burners often used for lighting with gas. Housekeepers should try to get the kind of burner that gives the best results with the gas used. It is a mistake to suppose that any kind of burner will do for any kind of gas. Accurate tests have been made in this direction, and it has been demonstrated that the same gas will vary in effectiveness as much as 65 per cent., according to the burner used. This is well understood by gas men, and should be the same by parties furnishing gas fixtures, who ought to see to it that their customers get the kind of burners that will give the most desirable results with the kind of gas furnished in their locality.

Trusting that this necessarily condensed treatise on "An Unpopular Subject" may enjoy, after all, a small degree of popularly and be of some use to your readers, we will now make an end of it.

[Continued from page 5.]

Destructive and Conservative Distillation of Mineral Oils.

[A paper read by Mr. John Laing, before the Royal Scottish Society of Arts.]

Now let us follow what takes place when breaking down an oil in the form of still before you. I have already pointed out that the oftener you distil a mineral oil you make it the lighter. Well, the oil in the first compartment boils first, the vapors pass over, get condensed, and fall into the second compartment. This oil, which has now fallen into the second compartment, is lighter than the body of the original oil in first compartment, and hence it requires less heat to re-evaporate it; it here meets with that less heat, and it is again redistilled into the third compartment, always getting the lighter at each distillation into each succeeding compartment, till finally it leaves the still. If you wish to bring off an oil of uniform specific gravity, you only require to keep your finishing compartment at a correspondingly steady temperature. For instance, if you wish an oil whose boiling point is 250° F., you must have your last compartment kept steady at that temperature, and no oil can possibly come over whose boiling point is higher. In order to better regulate the temperature of this last compartment, I have arranged a water jacket attached to it, with an inlet for cold water at the bottom, and an outlet for hot water at the top; the more cold water you run through this jacket will necessarily keep the end compartment the lower in temperature, and by this means you have a power of regulating the distillate to almost any gravity you want. [By extending these coils and leaving them exposed to the air the water jackets can be done without.—NOTE BY AUTHOR] If you try to overfire, you only increase the speed of the distillation into itself, and the cold oil constantly running from the condensers into the still guards it from harm. The still can be fed continuously, and I have made provision for the removal of residues in their most valuable form. In some cases, as in Russian oils, the unvolatilized residue, although liquid whilst hot, hardens on cooling into a pitch of first-rate quality, and in order to arrive at the proper point at which this can be obtained in the best condition, I have arranged a sampling vessel by which a small quantity can be run off, at any time, from the still bottom with perfect safety, and examined from time to time before running the bulk to the pitch-pit or tank.

Radiant heat is a very powerful agent in breaking down oil vapors (see Fig. 2), and if properly applied can be used with advantage. I

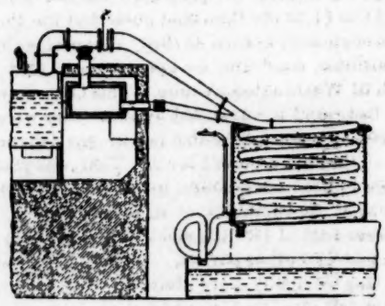

Fig. 2.—Radiant Heat—Longitudinal Vertical Section and Part of Primary Still.

have devised a method for its use, so that by simply passing the gases as they come from the still through a superheater exposing a large area of heated surface for the gases to pass over, they will readily get broken down and yield a lighter distillate according to the area, the temperature of the superheater, and the length of time the gases are in contact with it. The diagram explains the arrangement, and shows the connections from still to condenser, and also flue arrangements for the regulation of the heat.

The syphon trap at the end of the condenser will always ensure an oil-seal, and prevent any atmospheric air from passing to the superheater; this may be quite unnecessary, but I use it as a protective measure. It also shows arrangement for connecting the still with a vacuum pump; the discharge end of syphon would have to be lengthened and dipped into the oil according to the amount of vacuum to be balanced.

Distilling under pressure is another method by which this breaking down can be accomplished (see Fig. 3). Two methods have been employed to do this, but both of them carry with them such great defects that little has ever been done with them. One of these methods was to place the pressure valve direct on the swan neck from the still, and connect it direct to the condenser; but the vapors, under pressure, as they escaped from the still, rushed with so great a force through the

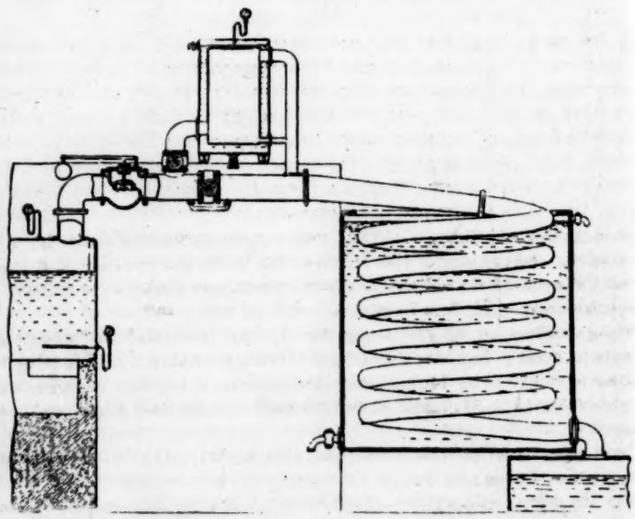

Fig. 3.—Distilling under Pressure—Longitudinal Vertical Section and Part of Primary Still.

condenser that a very large quantity escaped into the air uncondensed—this meant loss and risk from fire.

The other method was to place the pressure valve at the end of the condenser coil, but here we have practically the same results, for, when the oil under pressure escaped from the valve, it came away surcharged with gas, like an aerated water when the cork is drawn, and that meant loss of material, as well as risk from fire; and not only so, but all your

fittings being under pressure, could not be kept tight through the expanding and contracting action which was always at work.

The method I propose to employ gets over all these difficulties, and that in a very simple way. I place my pressure valve on the direct outlet from the still, and when the desired pressure has been overcome the gases immediately escape into a large iron box surrounded with cold water, which acts as a condenser, and the pressure is here distributed over such a large area that it is practically reduced to *nil* (*i.e.*, to atmospheric pressure). What condenses here runs out by an outlet at the bottom of the relief tank (as I will hereafter call it), and escapes at once through the condenser to the receiving tank; and what does not here condense rises up and over by an outlet at the top of the relief tank, and goes direct to the condenser, where it meets the condensed oil from the relief tank, and is condensed and run to receiving tank in the usual way. You will thus see that I get quit of all pressure immediately the gases leave the still, and by interposing this relief tank I am able to keep a hold of all the gases till they are condensed into liquid products, and the fittings are relieved of all pressure and remain tight.

Before proceeding with the conservative method of distillation, I would like to say a few words in further reference to the molecular condition of mineral oils. I conducted a number of very interesting experiments, which led me to the conclusion that the molecular condition of mineral oils took the form of aggregated molecules, whose affinity for each other was very great, and these I have called compound molecules. Of course, they are of ultra-microscopic magnitude. These compound molecules are of different sizes, and in proportion as these are large or small so is an oil heavy or light is specific gravity. The cohesive force, by virtue of which its compound molecules are held together, is not the same in all mineral oils of the same specific gravity. Some oils are more readily broken down than others. To put it popularly, they appear to me to keep together just like members of families; the larger the families you have together you have the denser oil, and according as you have a number of smaller families mixed through with the larger ones so you have oils giving light and heavier products in distillation. If you have a number of large families of stout and strong constitutions together, you will have a body capable of resisting a great amount of external force; in other words, you will have an oil which will not be readily broken down. If you have a number of large families together, and constituting an equally heavy oil as the other referred to, but the families are of a comparatively weakly constitution, it will take a less force to break them down, and here you will have an oil which is easily cracked up; the cohesive force has not been so great as in the other instance here referred to. In short, the compound molecules break down in proportion as this cohesive force is overcome; and, if you push this force to the extreme, I have no doubt you will at last rupture the chemical affinity, and your ultimate molecule will be broken up into its component parts, hydrogen and carbon, the former escaping as a permanent gas and the latter being left behind in the still; the great heat or force employed unites the bond of chemical affinity and liberates the atoms. I have now come to the last heading of my paper—viz., the Conservative Distillation of Mineral Oils.

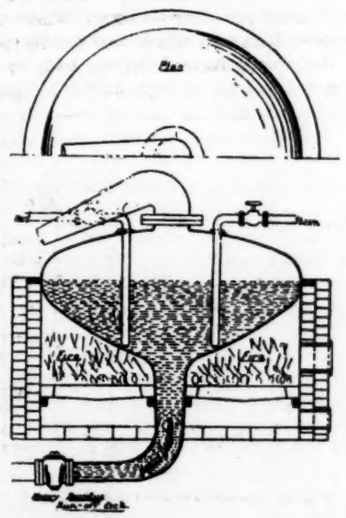

Fig. 4.—Conservative Distillation—Plan and Section of New Still.

From what I have said before, you will ready understand that if we wish to obtain an oil of maximum density and viscosity, we must distil it at as low a temperature as possible, and as quickly as possible, so that the oil vapors be preserved from being broken down by being kept too long in the region of great heat. Even in the most approved system at present of distilling mineral oils, we have not got over the difficulty which meets us when distilling for lubricating oils of high density and viscosity.

I have long been under the impression that we obtain far too low a percentage of these high density oils from the crude material we start with, and I think I have taken a step in the right direction in bringing before you, for the first time, this new form of still. Before describing the apparatus in detail, I think a few words of explanation as to the advantages to be gained by this form of still over those at present in use will not be out of place. In distilling material oils as at present, the contents of your still are gradually getting the denser as you proceed, and by the time you are three-fourths through with the distillation you have a very viscid material to deal with, and this, from its non-conducting properties and density, has a great tendency to cling to the bottom of the still and prevent the necessary heat passing to evaporate it quick enough, and hence you require to force more heat into the still to overcome the resisting action of the thick residue. In this way the sides of the still, above the level of the oil inside, get excessively heated, and the oil vapors coming in contact with this radiant heat are very apt to get broken down to a considerable extent, and thus yield a degraded distillate. If you pump in fresh oil on the top of this heavy residue, I find this oil does not, to any extent, dissolve the residue in the still, but lies on the top of it; and while this latter portion is being distilled, a granular pitch is being formed at the bottom of the still, and if you push your heat further you will convert this gradually into coke of a very hard nature, and you will have a considerable loss through the formation of permanent gas.

I have seen this very beautifully illustrated on taking off the end of a horizontal still I was working with. The layer of coke next the skin of the still was exceedingly dense in character, and it gradually got less dense as it increased in thickness, and towards the upper surface it was quite granular, and this again was topped with a pitch which remained plastic on cooling. You will thus see that practically all the heat which was distilling the oil on the surface was obtained from the upper sides of the still, and not from the bottom—very bad economy of heat indeed. This excessive heat at the end of the distillation is the main cause of the short life of many of our oil stills.

With regard to this new form of still which I have the honor to place before you (see Fig. 4), I think I have surmounted these difficulties. You will observe that in vertical section it takes the form of a cross, +, the head of which forms the attachment of the Swan neck, the wings forming the distilling chamber, and the tail-piece being that portion by which the pitchy residues are kept separate from the lighter oil under distillation. By means of a ball-cock arrangement, the still is kept always at a uniform depth. The heat is applied to the under surface of the wings all round the still, and as this distillation goes on, the heavy residue, which forms, gradually finds its way to the bottom of the tail-piece, and remains there away from the source of the heat, and when sufficiently heavy can readily be removed by the cock arrangements found there for that purpose. In this way you should never be troubled with coke forming, and your still should always remain clean. The depth of oil, through which the distilling heat has to pass, is always a constant factor, and the nature of the oil under the action of this heat is pretty nearly uniform. The bottom of the main body of the still or distilling chamber, as I call it, is inclined downwards and inwards, and this facilitates the withdrawal of the residual matter from the chamber, as it is formed, to the cooler region at the tail end of the still. You thus avoid all forcing of fires; no part of your still gets unduly heated; your gases have a shorter travel; and you work practically with a uniformly steady heat, the energy of which is employed in doing useful work.

I am strongly convinced, from the experiments I have already made, that such a form of still as I have placed before you this evening, whether worked in conjunction with a vacuum pump or not, would produce from a given oil a larger percentage of heavier oils of greater viscosity, and also of high melting point paraffine, than any other still at present in use.

Advantages of Forcing Lamps at the Expense of Their Life.

[By Mr. Carl Hering, in the *Electrical World*.]

It has long been well known that the efficiency of an incandescent lamp increases very appreciably the more it is forced, that is, the number of watts required per candle power of light becomes less the greater the current which passes through the lamp, or, in other words, the greater the voltage to which it is subjected. It is also well known that, on the other hand, the life diminishes very rapidly the more the lamp

is thus forced. As the total cost of the light increases by going to either of the two extremes of long life and poor efficiency on the one hand, and good efficiency with short life on the other, there must be some intermediate value for the life and the efficiency which would give the most economical results, considering both the cost of the lamp and the power required.

Numerous different methods have from time to time been suggested and used to determine this point with more or less success. But they have all apparently led one to believe that a long life is a most desirable feature, so much so that extremely long lived lamps were considered as great achievements in lamp making. More recently the tendency has been to increase the efficiency slightly and to diminish the life, but this may have been due to the lowering of the price of lamps, which would naturally lead to using higher efficiencies. But it appears now from the somewhat surprising results of the very interesting deductions of Mr. O'Keenan, described recently by Mr. Hospitalier, that the most economical point, considering all the factors involved, is very materially different from what was generally supposed, and that it is in fact cheaper to replace old lamps with new ones after only a few hundred hours, rather than to continue to burn the old ones. He shows that there is a point in the life of each make of lamps at which it will pay best to break the lamps, and he gives this point the appropriate name of the "smashing point."

The ingenious way in which he arrives at these results, though somewhat laborious, appears to be the most rational method of any of those suggested, as it is based on life and efficiency tests and takes into account every factor, including blackening of the bulb and falling off of the efficiency with age. He simply deduces a curve which shows for

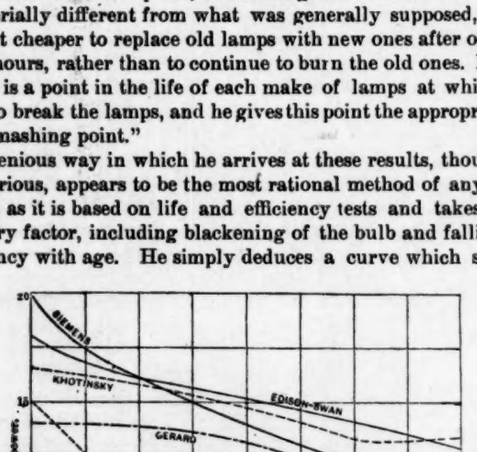

Fig. 1.—Candle Power as a Function of Time.

each hour during the life of the lamp what the average cost of the candle power hour of light from that lamp has been up to that time. These curves show that this cost is lowest at a certain age of the lamp, after which it again increases, and that it is therefore cheaper to throw the lamp away after that age.

These curves are deduced as follows: To start with, one must obtain from a life and efficiency test the curve, which we will call *a*, giving the amount of energy in watts which is being consumed by the lamp at each hour of its life; and, also, the curve, which we will call *b*, giving the candle power of the lamp at each hour of its life. A set of *b* curves for a number of different European lamps is shown in Fig. 1.*

From the consumption curve *a* deduce a new curve which gives for each hour in the life of a lamp the *total amount of energy in watt-hours which the lamp has received since it was started.* This new curve, which we will call *i*, which is the integral of the curve *a*, will approximate a sort of diagonal line passing through the origin. Multiply these ordinates by the cost of a watt-hour of energy in cents, or what amounts to the same thing, change the scale of ordinates so that they read in cost of a watt-hour in cents. Now add to these ordinates the original cost of the lamp in cents (which is equivalent to lowering the axis of the abscissæ by an amount equal to the cost of the lamp), or simply add this to the scale of the ordinates. The resulting curve, which we will call *c*, will then give for each hour in the life of the lamp the *total* cost of the lamp and the power up to that hour.

The calculation for determining the ordinates of this integral curve *I* is the most tedious part of the work. The ordinate for each hour of the new curve *I* ought to be equal to the sum of all the ordinates on curve *A* for *every hour* from the start to that particular hour. Or, in other words, for each hour the ordinates of the curve *I* is equal to the one for the preceding hour plus the ordinate of curve *A* for that hour. This involves a calculation for every hour of the life. A much shorter approximate method, however, is to take the mean ordinate on curve *A* for, say, every 10 hours, multiplying it by 10 and adding this quantity to the ordinate of curve *I* for the preceding 10 hours. The units for the scale for the *I* curves must of course be very much smaller than those for the *A* course. Those familiar with the use of the planimeter may use it to advantage for taking areas on the curve *A* and using these as ordinates for the new curve *I*.

From the candle power curve *B*, corresponding to those in Fig. 1, giving the candle power for increasing ages, deduce as described above a new curve which gives for each hour in the life of the lamp the *total amount of light in candle power hours which the lamp has given out since it was started.* This curve, which is the integral of *B*, will also approximate a sort of diagonal line passing through the origin; let this curve be called *D*.

It is evident that for any age of lamp the total cost of the lamp and the power *since it was started*, as given by the curve *C*, be divided by the total quantity of light in candle power hours obtained *since it was started*, as given by the curve *D*, the result will be the average cost of a candle power of light up to that age of the lamp; this is the quantity which we wish to find. If, therefore, the ordinates of the curve *C* be divided by those of the curve *D*, the quotients when laid off will give the desired curve. Such a set of curves for a unit of 10 candle power is shown in Fig. 2,* in which the cost of the lamp was taken as 40 cents and the energy at 20 cents per kilowatt hour. These curves are for the five different European lamps of which the candle power curves are shown in Fig. 1, which were taken from the tests by Mr. Ch. Haubtmann, published in *L'Ectricien* of Sept. 24, 1892, page 201. Referring

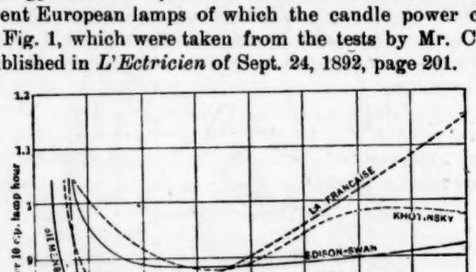

Fig. 2.—Specific Cost as a Function of Time.

to Fig. 2 it will be seen that the ordinates of each curve have a minimum value; this is the point at which the average cost per candle power hour is least; if the lamp is kept burning beyond that age it will be seen that its average cost again increases. This is the point which Mr. O'Keenan terms the "smashing point," for at that age it will be more economical to break the lamp than to continue using it. Perhaps the more dignified expression of "age of decline," or "most economical age," might be more acceptable to some.

Strange as it may seem to many, this point is reached for some lamps at the early age of 200 hours, and for none of them later than 500 hours. It is not unlikely that the American lamps would give about the same results. The curves will be given by the writer in a subsequent article if the desired information can be obtained.

Although the idea that a lamp should be worse than useless at such an early age may at first seem hard to believe, yet the method by which these results are obtained seems to be quite correct, as it is in fact nothing more than dividing the total cost of the light by the total amount of light received—a very simple, business-like way of calculating costs; and it is therefore a matter well worth the attention of lamp makers and consumers.

The minimum points in these curves owe their existence to the fact that the candle power and the efficiency diminish as the age increases; if both of these remained constant throughout the life, the curves in Fig. 2 would have no minimum point, but would approach to the base line; in which case the longer the life the better. This constancy is the incorrect assumption formerly made in such determinations and it naturally shows long life to be a very desirable feature. The present method, taking into account the blackening of the bulb and the loss of efficiency, is therefore undoubtedly more correct than the older method, in which this was left out of consideration. To keep an old blackened

* Taken from *L'Industrie Electrique.*

* Taken from *La Lumiere Electrique.*

lamp in use is well known to be a foolish luxury if the consumer has to pay for the power, but it was not known before just at what point it is cheapest to stop it.

The conclusions to be drawn from these curves are naturally that, as the life of the lamp is of no consequence after a few hundred hours, it will therefore be far better to force them, thereby obtaining a greater efficiency and cheaper light. Forcing them will, on the other hand, blacken them at an earlier age, but as the efficiency is so much higher to start with, it will doubtless be a gain in the end, provided such forcing is not carried too far.

As this method of finding the most economical age is deduced from the actual candle power received and the total cost, including the lamp, it applies only to cases in which these factors are to be considered, as, for instance, in all private installations. A central station manager, for example, who does not seem to be concerned with the actual candle power of the light, provided only that the lamps are labeled "16 c. p.," will of course run them until they die a natural death. The same with parties whose power costs nothing but whose lamps do; also in places where the diminution of candle power with age is of no great importance.

The most economical age as shown by the curve will also depend upon the relative costs of the lamp and the power. As the power becomes more expensive, the minimum point of the curve will move to the left; that is, it will be more economical to force the lamps still more, while, if the price of lamps becomes greater, the point will move to the right, showing that it will be more economical to run them longer.

In conclusion, it is no more than fair to others to say that the idea of taking into account the diminution of the candle power and efficiency for determining the point at which the life is practically ended was suggested some time ago, at least as far back as the June meeting of the American Association of Electrical Engineers, if not earlier; but the ingenious and rational method devised by Mr. O'Keenan for determining the exact point appears to be new.

Liquid Fuel for Steam Making.

By F. R. Hutton, C.E., Ph.D., in *Engineering Magazine.*

The combustibles which are at the service of the engineer for industrial purposes come to his hands in three forms. The solid fuels are coal and wood, lignite and peat, in their natural or derivative forms; the liquid fuels are petroleum in its crude state or as a product of refining or distillation; and the gaseous fuels are either natural or artificial fuel gas. The solid fuels are historically the first; the liquid and the gaseous have only come to the industrial importance which they now occupy during the last 30 years.

The combustion of a fuel being a union with oxygen, which is a gas, it is necessary that the fuel, whatever its form, be first reduced to such a fine state of division that it shall be possible for the union to take place rapidly. For the solid fuels there is necessary a certain consumption of energy in the form of heat in bringing about this fine division, either by a process analogous to distillation, by which gas is made, which subsequently unites with oxygen, or else by union with oxygen only on the surface of the solid particles of fuel. In the latter case, from the relative slowness of the combination, the temperature of the flaming furnace is kept at a lower point than where the form and fine state of division of the fuel permit this chemical union at a more rapid rate.

Confining attention to the subject of fuels in a liquid form, it may be stated that the first experiment in this country upon any considerable scale seems to have been made at the Morgan Iron Works, in New York City, in 1865, and is identified with the names of Colonels Foote and Julius W. Adams. The very high price of coal at that time, and the recent large discoveries of petroleum, gave special interest to this series of experiments, although the previous investigations by Professor R. A. Fisher, of New Haven, had shown that the question of the substitution of oil for coal as a fuel was largely if not solely an economic question, affected by the relative cost of the two materials and their accessibility in any locality.

The English experiments of the same period bear date of 1864, under the system of Mr. C. J. Richardson. These were specially stimulated by the marine interests, with a view to the advantages offered by oil as a fuel on board ship for strategic and practical reasons, and secondly, by reason of the special problems facing engineers in the colonies, where coal was difficult to obtain for locomotive purposes, and where, in the dry season, it was of prime importance that no spark should be discharged from a locomotive stack to ignite a parched and inflammable vegetation.

In the development of the use of oil as fuel three great classes of furnaces have been put forward. That class in which the oil is introduced to the fire box in a liquid form embraces four types. The first is that in which the oil is delivered into pans in the fire area, where it is set fire to with the access of what air can be got to it—a method obviously imperfect, uneconomical and accompanied with great waste in the form of smoke. In the second form the oil is delivered into grooves upon a step grate so that it overflows from step to step, meeting the air supply between levels. This secures a much better union with the air and seems to work well, particularly in metallurgical practice. The third type may be called drop furnaces, where the oil drips from a number of pipes on to the combustion area, and is there ignited. The fourth type introduces the oil as a fluid up from below through a porous bed of lime, or other similar material, at the top of which it meets the air for combustion and burns as from a wick. This is one of the most satisfactory methods of using the oil as an undivided liquid, but it presents the difficulty that perfect combustion cannot be insured for any great length of time. The heavy constituents of the oil accumulate in the porous layers and gradually interfere with the flow.

The second great system for the combustion of oils involves the principle of finely dividing the oil by means of a jet of air or steam moving at high velocity and forcing the oil in spray form into the fire box. The burner in all systems of this class is practically an injector, and the steam or air carries the fluid with it usually in an annular jet, and its fine state of division brings it to a condition in which it can combine rapidly and completely with the air necessary for combustion. It will be seen that in this system a subsidiary apparatus must be depended on when the fire is first to be started. There must be a pressure of steam either in the boiler which is being fired or in some other boiler, in order that the steam jet can be started, or else the fire must be started with solid fuel, and the use of oil begun only when the necessary pressure has been accumulated.

Where air is used to bring in the oil, a pump is required to produce the necessary pressure, and for this reason the plan of using steam as the inducing medium is practically the only one which can be used in locomotive service where subsidiary apparatus must be reduced to its lowest terms. As to the relative advantages of air and steam, when they are equally available, steam would appear to have the advantage over air, in that it is at a higher temperature than air usually is when it enters the nozzle of the burner, and that it does not entrain with it inert matter, such as nitrogen, which has to be heated up by the flame, but does no useful service in the combustion. Moreover, if the temperature of the flame is high enough to dissociate the oxygen and hydrogen which formed the steam, while the heat absorbed in this dissociation is the same as that given out in the combustion of the hydrogen of the steam, the mechanical effect is to increase the proportion of hydrogen in the flaming mass, and thereby to increase the length of the flame, with a consequent gain in its radiating effect. While there is no gain in units of heat, there may be a gain in the efficiency of the flaming mass to transfer its heat to the water in the boiler. On the other hand, there is required for the combustion a certain weight of air, and its introduction with the oil in the jet secures an intimate mixture of this air with the oil favorable to its union with it in combustion, and the specific heat of air is 0.23, while that of steam is 0.48, so that more heat is required to bring the vapor of water up to the temperature of the products of combustion than is required to bring air to the same temperature.

The fact, however, that the steam system requires no air pump will be a preponderating argument in its favor in many places. For the heating of forges also, the steam would appear to be an inconvenient diluent of the flaming mass.

It would be impossible here to allude in detail to the various forms of burner which have been presented for the use of oil as fuel. There are several features, however, which a good burner must have in order to work satisfactorily. The great difficulty in any form which has its nozzle near enough to the flame to have combustion begin at the very orifice is that the oil will carbonize at the orifice and gradually stop it up, sometimes checking it altogether. The burner must be of such construction that these pasty or hardened accumulations may be easily removed without stopping the apparatus, or else the burner must be fitted in duplicate, so that the one can be used while the other is being cleaned.

The best known injector of this class is that brought out by Mr. Thomas Urquhart, locomotive superintendent of the Grazi-Tsaritzin railway in southeastern Russia. His arrangement is a steam system, and the nozzle for the injector for oil enters within, but does not pass through, a thimble inserted in the rear water leg of the locomotive

boiler. The flame does not reach the nozzle of the injector, and the trouble from carbonization or cooking of the oil particles is largely eliminated. If this should occur, or if the annular oil channel should become clogged by any matters in the oil, the steam tube can be retracted by a screw motion operated from the foot-plate of the engine, and the steam jet, which is one of the most detergent elements known in the arts, will immediately blow the opening free and clear.

In any of the comminuting systems of this class care must be taken that the flaming particles of oil coming into the fire box at high velocity from the jet should not impinge upon a particular spot of the heating surface. In all the systems it is aimed to secure this end by interposing in the path of the jet a baffle plate of fire brick or similar material. In the Urquhart furnace the fire brick is built up at the the front end of the fire box nearly to the height of the lower row of tubes, and an arch is sprung across from side to side of the fire box, very much in the position in which the usual arch is found in bituminous fire boxes, and it is in this blind rampant archway that the intensity of the combustion takes place. This mass of fire brick becomes white hot, and serves not only to store and radiate heat, but also to ignite the jet when it is cut off for a stop of the train. An objection to all burners of this class is the noise which they make, but in many places this need not be more objectionable than the noises in many fire rooms from quenching the ashes by turning a hose jet upon them. It is comparatively easy to prevent annoyance from explosive ignitions of the oil, if the precaution is taken to put into the fire box a lighted wad of waste shavings, and, after this, to turn on first the steam, and then the oil, to the burner. Where the fire chamber can become filled with vapor of oil before the flame is applied, there may be enough carbon ready to combine instantly with oxygen when the flame is applied to cause an explosion, which is always startling and may be dangerous.

The third great system of furnaces for burning oil embraces those in which the oil is first made into gas a and is burned in the fire box in true gaseous form. This principle was applied in oil firing in this country as early as 1867, when a furnace of this sort, devised by Colonel Foote, was tried in the United States gunboat "Palos." A flat coil of pipe conveying the oil to a larger pipe occupying the place of the bridge wall was brought up to a high heat by the combustion of the oil delivered in burners underneath the coil and in front of the retort. Superheated steam similarly heated by the issuing flame from the burners brought the whole mixture up to a very high temperature, and the products burned as a gas. In this case, of course, the gas and steam streamed out of the burners at a high velocity.

The Archer fuel process is essentially similar in principal, forcing the oil by a pump through a circular coil of pipe, which is kept at a high temperature by an annular fire surrounding the central retort, which, in this system, is called the "thermogen." Steam, in a similar coil, is superheated, enters the thermogen with the gasified oil, and passes with it through the necessary regulating valve to the furnace of the boiler under which it is to be used. Unlike the vapor system already mentioned, it enters the furnace at a comparatively low velocity, without the rush and roar characteristic of so many of the other systems, and it is claimed not only that this peculiarity results in the consumption of less oil for a given amount of evaporation, but also that there is avoided the difficulty present in some of the comminuting systems of the formation on the heating surface of an incrustation due to the constituents of the oil which are not thoroughly burned in the fire-box, but are carried forward to be deposited upon the cooler metallic surfaces. The difficulties of the gas system would appear to be those attaching themselves to the use of a retort which either could become clogged from residual matter in the oil, or which would deteriorate from the action of the flame and from expansion at high temperatures.

The advantages which can be urged in favor of the use of liquid fuel are many and important. First, the crude petroleum has a higher calorific power than most of the coals, weight for weight. Where a crude oil can be used from which certain of the burning compounds have not been removed by refining, it is possible to secure a calorific power of 21,000 heat units, while the calorific power of coal may be put at from 12,000 to 13,000 heat units. This means that one pound of oil is equivalent to 1.6 pounds of coal. It is often called 1¾. English experimenters, using a lower calorific power of coal, have obtained results correspondingly more advantageous for oil. This consideration has a very important bearing in both locomotive and marine service. In the locomotive tender it is possible to diminish the amount of fuel which must be carried between terminals to keep up a given speed or hauling power, the dead load is diminished with consequent obvious gain. But more important still, if there can be burned over a given grate area a fuel of higher calorific power, it become possible to make more speed from a given boiler in a given time, which means that the cylinder capacity can be increased without transgressing the limits of volume of boiler surface of grate which the conditions of practice in respect to gauge and curvature impose upon the designer of such machinery. In marine practice, not only is the ship lightened or the possible length between fueling stations increased, but, by a parity of reasoning, a smaller bulk of boilers can be expected to do a given amount of work.

Outside this fundamental and far-reaching advantage of a high-grade liquid fuel, there are many practical advantages which need only to be enumerated to convince anyone of the great convenience which is permitted by the use of liquid fuel. These are:

1. Diminished waste of fuel from the loss of combustible with the ashes and gases. In locomotives there is a loss of fuel through the stack, rated usually at from 10 to 20 per cent., according to the intensity of the draft. This is saved in the use of liquid fuel, besides which there will be no sparks to be taken care of in the smoke box, if arrested, or to set fire to property, if blown out.

2. A reduction in the cost of the labor for handling the fuel, which is twofold. There is in most plants an expense for handling coal into bunkers, and a second handling from the bunkers into the fire-box. The oil handling for both of these steps is mechanical, while with the solid fuels the second step is but rarely so. It is possible, therefore, for one man with oil fuel to take care of many more boilers than with solid fuel.

3. In cities it is a matter of convenience and economy not to provide for the disposal of ashes, which from the solid fuels amount to from 200 to 300 pounds or more to the ton, and, where the plant is large, have to be provided for by special contract outside of the usual facilities offered by the municipal government. There is no flue dust to clog fire tubes and diminish their efficiency; but this may sometimes be offset by a deposit of oil residuals in them.

4. Where no firing tools are required, less injury is done to the brickwork of the fire-boxes, and grate bars do not deteriorate.

5. Repairs to the brickwork of the ash pit and the boiler room floors are diminished, as the tendency to crack when heated by hot cinders and quenched by water is absent.

6. Better regulation of the fire is possible, as the demand for steam may vary. This diminishes losses of heat from blowing off at the safety valve, which doubtless often amounts to a loss of 5 per cent. or over.

7. The opening of the furnace doors for firing and cleaning is made unnecessary, so that the boiler may be expected to suffer less from unequal expansion and contraction.

8. Where the engine room is also the boiler room, the absence of dust and ashes about the machinery is of manifest advantage.

9. The absence of sulphur is favorable to the life of the boiler plate, and this is especially an advantage where there is moisture in the solid fuel, which permits the formation of an active sulphurous acid, corrosive in its character.

10. The labor of the fireman is made much more agreeable, inasmuch as all the work of cleaning and the strain of standing in front of open furnace doors are done away with.

11. Aboard ship, on the locomotive, and in cities, it is easier to secure a combustion as nearly smokeless as a due regard for economy will permit. For war purposes smokelessness is a matter of considerable moment, inasmuch as a trailing banner of soft coal smoke will betray the presence of a steamer otherwise invisible below the horizon. In the locomotive there are no cinders to annoy the travelers or the train crews.

12. In the contracted fire rooms of vessels the temperature of the room can be kept lower, and in tropical latitudes the lot of the firemen will be very materially mitigated for this reason, as well as by diminishing the severity of their labor.

13. On shipboard liquid fuel can be stowed in places where solid fuel could not be put.

The disadvantages attached to the use of liquid fuel will differ according to the nature of the oil employed. In this country two forms of oil are presented for fuel use. One is the product of the oil wells in Pennsylvania and Ohio—the crude petroleum as it flows from their mouth, sometimes more specifically designated as Lima oil, from the town of that name. In certain cities the limitations imposed by health boards and fire departments preclude the use of this material, and their reasons constitute two objections to be urged against the great bulk of available crude petroleum. The first of these objections is its inflammability or high flashing point. This means that be-

cause of the presence in the oil of light components which distill off in the form of vapor spontaneously, or under agitation, or at very low heats, there will be given off a light hydrocarbon vapor which will form with air a mixture that will ignite explosively when an open flame is brought anywhere near it. This peculiarity has a very important bearing upon the use of crude oil on board ship, where it would be kept in confined spaces, or in the locomotive, where naked flames are likely to be found around the oil tank. The second great difficulty with crude oil is its offensive smell, which has a very important effect in limiting its use.

The other form of oil used for fuel is the product of the refining process after the elimination of the naphthas and the kerosene or burning oils from the crude material, which leaves behind about 60 per cent. of the original quantity, having a specific gravity averaging 40° Baume, and a flashing point above the boiling point of water. This obviously is a very much safer form of oil for fuel and is not objected to by fire and insurance corporations, provided only that certain conditions looking towards the safety of the premises in case of accident are complied with. The usual requirements are that the storage tanks should be of iron with tight covers provided with ventilating pipes and overflows; that the tanks if possible should be underground, and the piping also; and that the main tank, of larger capacity than the distribution tank, from which the oil passes to the burners, should be, if above ground, surrounded with a dike or embankment, enclosing a space large enough to hold the entire contents of the tank.

Oil of this class, having no volatile material remaining, gives off little or no odor, but there has been sacrificed not a little of its calorific power and of its length of flame. It will contain 85 per cent. of fixed carbon and upwards of 13 per cent. of hydrogen in the ordinary run of samples, the balance being oxygen and impurities, so that it will compare in composition with coal of the bituminous class so much used for steam purposes, and will have by no means so much higher a theoretical calorific advantage over the solid fuels.

The disadvantages common to both forms of oil fuel are, where the vapor systems is followed, the noise made by the burner, and, in the gaseous system, the sacrifice of part of the fuel efficiency for the distillation of the gas, and in both the air vapor and the gaseous system the necessity for auxiliary and additional apparatus, with their first and running cost.

It should be kept in mind that the production of coal is much in excess of the present production of oil.

But the final and conclusive argument is the commercial one, as to the relative cost of an equal weight of calorific efficiency in solid and liquid fuels. This calculation may be made to seek the answer in either equivalent price per ton of coal or equivalent price per barrel for oil.

The product of multiplying the weight of oil per gallon in pounds by the number of gallons in a barrel is the number of pounds of oil in a barrel. If this product be multiplied by the ratio in heating effect of 1 pound of coal to the pound of oil whose calorific power is known, we have a product which can be handled in comparison with the weight of solid fuel in a ton. If we divide the number of pounds in a ton by the product first obtained, and multiply the result by the price of oil per barrel, we get a figure showing what coal must cost per ton in order to be of the same cheapness. On the other hand, if we divide the above product by 2,000 or 2,240 and multiply the result by the price of coal per ton, we obtain the equivalent price per barrel which oil must cost if it is to be no more expensive than solid fuel. The cost of coal in this second calculation must include the labor and expense of handling the coal and ashes, which will be dispensed with where oil is the fuel, and the price of oil per barrel in the first calculation must similarly be taken as delivered to the consumer and not as its price at the wells.

A calculation made in 1889 by Mr. H. F. J. Porter for the use of oil under the boilers of an extensive steam plant in New York City showed that at the prices then prevailing for fuel oil of the quality at that time obtaining, 6.7 barrels of oil were equal to a gross ton of coal, and that with the conditions at the plant in question it would be possible to pay $3.17 per long ton of coal, or that the equivalent price of oil was three mills per pound. Readers of this magazine will have noticed that in the department of Mechanics, for August, 1892, it was stated that oil at 2.4 cents would compete with coal at $3.95 per ton, but where coal was $3.10 per ton and oil at 2.25 cents per gallon, the coal was cheaper. Where the price of coal drops to the neighborhood of $1 to $1.50, oil even at 1.5 cents per gallon is much more costly. An interesting table of comparative values computed by the above method was presented in the lecture by Dr. Dudley above referred to, and will be found in Volume XCVI. of the *Journal of the Franklin Institute.*

Electric Lighting at Topeka, Kansas.

[Communicated by Mr. Lewis Kingman, to the Am. Soc. Civil Engineers.]

There are few wants more necessary in a well regulated community than light. After securing a generous supply of pure fresh air, good wholesome water, clean streets and surroundings well drained, we need light by night as well as by day. During the last few years many of our smaller cities, seeing the improvement made in larger places, have secured electric light plants. Some, from a spirit of rivalry, have gone into these enterprises blindly, without counting the cost or carefully considering the questions involved. The strong convincing argument in favor of the arc lamps is the great concentration of light in one lamp. But the light received is as the square of the distance lighted, a fact that is often overlooked.

There are many inquiries constantly being made as to the cost and operation of an established plant. One of the first asked is, does the city own its plant? A question in municipal economy which should receive more attention. That a city should be free to supply its own needs and that of its citizens at cost, without the presence of middlemen to overcharge or discriminate, would seem self-evident.

The next important question is the cost. In reply to such questions, the author has prepared a tabulated statement, taken from the reports of the superintendents, which covers the operation of the plant for the last 26 months, giving the number of nights and hours run each month and the principal elements of cost, together with the cost of fuel for each horse power for one night and hour.

The plant belongs to the City of Topeka; it was contracted for in February, 1888, and furnished by the Jenney Electric Company, of Indianapolis. There are 184 double carbon arc lamps, 3 boilers 16 feet long, 54 inches in diameter, with 45 flues 4 inches in diameter; 3 Ball engines of 75 horse power with 80 pounds of steam pressure, intended to run 250 revolutions a minute, 6 dynamos of 30 arc lamp power, connected with 6 circuits which together have 24.72 miles of line and 33.5 miles of wire; the line is suspended upon 30-foot cedar poles, and the lamps are suspended at the center of the street intersections between two 40-foot poles. Soon after starting it was found necessary to use more than 80 pounds of steam pressure, and in doing this the capacity of the boilers was found inadequate, except with the best bituminous lump coal. From the tests and experience of a superintendent who was in charge of the plant about 1 year, it was found that the three engines had to work up to 235 horse power to keep the lamps burning steadily. The exact actual horse power record has not been kept during all this time.

The accompanying table shows some irregularities. Owing to lack of boiler capacity the plant has to be shut down two nights each month to clean them. This is usually done on moonlight nights but sometimes it is cloudy and the moon obscured, much to the annoyance of the people. In October, 1891, the plant was shut down for fifteen days to reset the boilers.

The monthly statement of the cost of coal is for coal received and paid for during the month; this comes by the carload, which is ordered as needed, and very little is kept in stock at any time. Owing to the lack of capacity of the boilers, the poorer and cheaper coal, such as is used by other electrical plants in the city, cannot be burned.

An expert tested some of the lamps without the knowledge of the superintendent and operators, and found as an average of seventeen lamps in different parts of the city a pressure of 23.15 volts, a current of 19.0 amperes, and an electromotive force of 439.85 watts. The manufacturers of electrical plants using arc lamps have fixed an arbitrary standard of their own for candle power. Six of the largest companies allow from 432 to 480 watts for a 2,000 candle lamp; the average of these is 450 watts to the lamp or 4.44 candles to the watt. The author has endeavored to find some reason for these assumptions, but knows of none except that they overrate their lamps for what they can gain by imposing upon their customers. The best authority that he can find on the subject is Gordon Wigan, A. M., whose work was printed in 1884 by Casel & Co., New York, and who makes one watt equivalent to 1.63 candles, and cities a test of candle power at the Paris Electrical Exposition of 1881, when the Brush lamp was tested and shown to be 741 candle power. By the American manufacturer's average arbitrary standard, the 17 lamps tested averaged 1,953 candle power, allowing 4.44 candles to the watt; but taking Wigan's and the European practice our lamps are only 717 candle power, allowing 1.63 candles to the watt.

This is a great difference, when it is considered that we use the same

COST OF OPERATING THE TOPEKA ELECTRIC LIGHT PLANT, OWNED AND RUN BY THE CITY OF TOPEKA, KANSAS.

Year and Month.	Nights Run During Month.	Hours Run During Month.	Average Number of Hours Run.	Coal. Tons.	Coal. Cost.	Cost of Coal per Horse Power: Per Night.	Cost of Coal per Horse Power: Per Hour.	Cost of Carbons.]	Cost of Globes.	Cost of Oil and Waste.	Cost of Repairs.	Expenses, Insurance, Telephone.	Pay Roll of Superintendent and Labor.	Interest on Cost of Plant, at 6 per Cent.	Total Cost. Entire Expense per Month.	Cost per Lamp per Month.	Cost per Lamp per 100 Hours.
1889. Nov.	28	340.03	12.14	236.0	$566 40	8.60	0.71	$110 07	$13 50	$22 15	$12 15	$32 88	$483 32	$377 24	$1,517 71	$8 25	$2 43
Dec.	29	373.47	12.88	261.0	626 40	9.19	0.71	142 40	8 25	27 27	133 74	29 58	531 00	277 24	1,775 88	9 65	2 59
1890. Jan.	29	357.40	12.32	222.0	532 80	7.82	0.63	123 00	9 00	23 31	180 13	29 58	497 50	277 24	1,694 27	9 21	2 58
Feb.	26	298.73	11.49	216.9	520 56	8.52	0.74	123 00	13 00	23 45	90 21	32 59	508 33	277 24	1,632 83	8 88	2 97
March	27	274.83	10.18	194.85	459 40	7.24	0.71	109 67	13 38	25 29	24 06	29 38	516 50	277 24	1,603 80	8 71	3 17
April	30	265.42	8.84	190.0	456 00	6.47	0.73	70 27	8 17	32 25	27 47	31 83	523 38	277 24	1,514 13	8 23	3 11
May	28	171.92	6.14	156.0	374 40	5.69	0.93	50 90	3 50	19 60	94 07	37 93	515 75	277 24	1,391 38	7 56	4 17
June	27	132.91	4.92	76.0	182 40	2.87	0.58	50 00	3 50	21 36	100 78	32 48	516 50	277 24	1,311 96	7 13	4 86
July	28	146.34	5.22	144.0	345 60	5.25	0.82	70 27	2 50	25 32	57 90	32 73	467 75	277 24	1,419 85	7 72	4 82
August	28	182.50	6.51	154.3	403 66	6.36	0.81	81 98	5 00	22 10	64 72	34 48	523 41	277 24	1,396 59	7 59	3 75
Sept.	27	211.69	7.87	110.0	361 11	6.15	0.75	79 56	9 00	22 00	79 78	49 03	525 00	277 24	1,417 53	7 70	3 83
Oct.	25	204.04	8.16	126.35	385 37	6.83	0.80	74 02	3 50	15 61	86 11	31 78	530 25	277 24	1,417 53	7 70	4 07
Nov.	24	206.00	8.58	123.4	373 70	6.36	0.80	83 65	6 00	19 89	100 29	38 08	529 50	277 24	1,371 64	7 46	4 75
Dec.	25	198.25	7.93	122.65	374 08	6.63	0.84	71 70	3 50	17 30	195 94	33 26	528 98	277 24	1,335 82	7 26	4 60
1891. Jan.	24	189.17	7.88	83.75	249 18	5.05	0.67	65 72	2 50	13 83	102 11	36 73	525 75	277 24	1,280 90	6 96	4 90
Feb.	21	157.50	7.50	102.80	302 73	5.60	0.81	71 70	3 00	13 98	41 35	37 36	525 00	277 24	1,272 78	6 92	5 45
March	23	158.50	6.89	109.0	317 42	6.43	0.95	64 80	3 00	10 30	56 29	45 56	525 00	277 24	1,229 60	6 68	5 66
April	21	141.83	6.75	101.0	294 99	5.46	0.99	60 00	4 00	9 92	39 80	47 46	525 00	277 24	1,183 84	6 43	4 63
May	23	127 05	5.52	86.8	264 74	4.89	0.95	55 20	4 00	10 36	67 57	40 91	525 00	277 24	1,266 54	6 88	4 00
June	23	118.08	5.13	75.13	230 73	3.63	0.71	55 80	4 00	14 62	171 95	33 31	525 00	277 24	1,437 05	7 81	3 11
July	27	138.75	5.14	90.10	274 80	4.17	0.68	72 00	3 00	20 70	730 69	35 61	510 00	277 24	1,949 24	10 59	7 51
August	28	172.05	6.14	108.95	331 55	4.70	0.56	72 00	2 00	10 85	110 59	35 16	533 10	277 24	1,477 99	8 03	3 29
Sept.	30	251.05	8.37	323 30	8.60	0.98	60 00	2 00	6 40	19 50	74 29	35 86	525 97	277 24	1,432 19	7 78	3 43
Oct.	16	140.75	8.79	106.00	395 70	6.01	0.69	96 00	4 00	12 40		33 01					
Nov.	28	244.41	8.73	136.45	415 28	6.54	0.77	90 00									
Dec.	27	227.50	8.43	143.20													
Totals	672	5,430.17	Av.,8.08	3,587.03	$9,646 16	Av.,6.11	Av.,0.76	$2,146 11	$159 05	$504 35	$3,045 78	$905 84	$13,420 99	$7,208 24	$37,036 52	Av., $7 74	Av., $3 71
Per cent. of total expense					26 04			5.79	0.43	1.36	8.23	2.45	36.24	19.46	100.00		

Cost of lots and buildings, $8,559 33; cost of plant, poles and wire, $46,888.65; total cost, $55,447.98.

The plant consists of a building and a lot with a railroad switch in the rear; there are three boilers and three engines, worked up to 235-horse power; there are six Jenney, Indianapolis are dynamos of 30-lamp power each. There are six circuits, with 24.72 miles of line and 33.5 miles of wire. The line poles are 30 feet long, of which there are 943. The lamps are suspended at the center of the street intersections between two 40-foot poles, one lamp to every other intersection, making them 1,100 feet apart one way and 800 feet the other. Together there are 184 arc lamps rated at 2,000-candle power. An average test at the lamps showed a pressure of 23.15 volts and a current of 19.0 amperes, 439.85 watts, or 1,953 nominal candle power.

English standard candles as are used in Europe and elsewhere, for our standard in this country.

The location of the electric lamps in our city has been a subject of much criticism, with one lamp at every other street intersection; the lamps are about 1,100 feet apart one way and 800 feet the other; the intervening intersections are not well lighted, which is hardly fair to the people living there. With one lamp at every intersection the light would be of much more value, even though the intensity was only one half of the light of the present lamps.

We have in addition to our electric lamps 222 vapor lamps furnished and lighted by contract at $1.75 per month. These are located in the outlying districts. People complain because they are so insignificant as compared with the arc lamps, and when one compares a vapor lamp of 10 candle power with a 700 candle power lamp, it is not much to be wondered at that some of these districts should complain through their representatives.

The city of Topeka is spending $21,260 a year for lighting its streets, and yet people are not satisfied. About one-half of those inside of the electric light district feel that an injustice has been done them, and all of the people outside of this district seem to think they ought to have as good light as the electric lamps furnish, as they are assessed in the same proportion as those who have them.

What we need is a system of lamps at every street intersection, with one circuit covering the business portion of the city on which the lamps shall have an intensity of 1,000 actual candle power.

Then with circuits covering the residence and outlying districts on which the lamps shall have an intensity of 200 candle power. One objection, perhaps, to this would be the large additional number of lamps to clean, adjust and take care of; another would be the long distance for the transmission of the electric current and consequent loss or leakage.

The present arc lamps are good, perhaps perfect in themselves, yet the cost is so great that a city occupying a large territory cannot expect to light all and do equal justice to its citizens.

The Edison lamps have not the candle power suitable for street lighting, but it would seem to the author that a system between the two would be more suitable for many of the growing cities in our country.

The cleaning of the arc lamps and the globes is a large item of expense and is seldom done perfectly. Fifteen per cent. of light is absorbed by a good clean globe, 70 per cent. by an opal globe, and about the same amount by a dirty globe. The rods of an arc lamp must be kept clean or it will fail to burn, and the cleaner is at once reminded of his duty; but he can allow the globes to become obscured so that from 50 to 70 per cent. of the light is absorbed without any serious complaints from an average citizen. Municipal engineers are largely interested in the question of light. We should try and secure its proper diffusion, that equal justice may be done to all. An engineer should first know what his city needs, and then be able to advise, and prevent a fluent agent of a strong illuminating company from selling an extravagant plant, poorly adapted to the wants of the people.

THE works of the Great Barington (Mass.) Gas Company were slightly damaged by fire last month.

Death of Mr. John Somerville.

We regret to record the death, on December 15th, 1892, of Mr. John Somerville, whose services in connection with the engineering department of the South Metropolitan (London) Gas Company have made him famous in the annals of the gas industry. Deceased was a brother of Mr. James Somerville, Engineer of the Indianapolis (Ind.) Gas Company, and was well known to our readers, through his communications to the JOURNAL, to which he was an occasional contributor some years ago. The following obituary of deceased appeared in the *Journal of Gas Lighting*, published December 20th last:

In the person of Mr. John Somerville, Engineer of the Bankside station of the South Metropolitan Gas Company, who died on Thursday last after only a few hours' illness, the world of British gas engineering has lost one of its best known, most popular and ablest of leaders; for John Somerville was a real leader and master in his profession, albeit one of the most unassuming of men. His experience was deep and wide, and, being dominated by a strong creative genius, bore fruit in a rich crop of original contributions to the technology of gas manufacture. Born in the south of Scotland in 1832, Mr. Somerville was destined to make his mark upon the gas industry of both England and Ireland; but he had no connection with the gas supply of his native land. His first employment in what was to be the work of his life was at Wolverhampton; but while still a young man he came to London, and took service under the Commercial Gas Company. His next engagement was at the Thames street works of the old Greenwich Gas Company, under the late Mr. Hunter, whence he went to Maidstone in 1858 as assistant to the then Engineer and Manager, Mr. Bartlett, whom he succeeded the following year. He there laid the foundation of his reputation as a carbonizer and constructor, and attracted the favorable notice of the late Mr. T. G. Barlow, who recommended him for the apparently more desirable position of Engineer of the Alliance and Dublin Consumers Gas Company, which appointment he accepted in 1869 on the invitation of the Directors. His Dublin, experience, however, was embittered by the dissensions that have ever notoriously characterized the relations of the Company and the Corporation, and he terminated his connection with the gas affairs of the Irish capital in 1874, subsequently employing himself in the management, under leases, of the gas works at Newbridge, Mullingar, Roscrae, Thurles and Kilkenny.

Mr. Somerville quitted Ireland in 1878, and returned to London; taking an engagement at Rotherhithe, the headquarters of the Surrey Consumers' Gas Company, under Mr. Finlay. Here he remained only a few months; being engaged in 1879 by Mr. George Livesey, the Chief Engineer and Secretary of the South Metropolitan Gas Company, for the special work of preparing, under his direction, the various drawings for the first of series of the great gasholders which have resulted in the crowning achievement of the East Greenwich six lift holder, recently completed. This engagement proved permanent; Mr. Livesey being quick to appreciate the sterling qualities of his new assistant, to whom he gave the management of the Bankside station (shortly afterwards taken over by the South Metropolitan Company upon the amalgamation of the Phœnix Company), and whom he associated with himself and his brother and successor in the engineership of the company—Mr. Frank Livesey—in the execution of the notable extension works that have been necessitated by the phenomenal growth of the South Metropolitan undertaking.

Mr. Somerville's name is honorably distinguished in connection with the introduction of machine stoking for gas retorts, the perfecting of gaseous firing for retort settings, coke breaking machinery, and multifarious other improvements in gas making plant and apparatus. He was a prolific inventor. As a constructor he was bold, capable and safe—understanding how to combine economy with efficiency; and as a designer of gas plant he was always in the front line of his profession. As an employer he was respected and beloved. The youthfulness and elasticity of his mind enabled him to assimilate everything which recommended itself to him as real progress in his art; while his unfailing kindness of disposition was shown in his readiness to impart information to all who came to him with the claim of a common calling.

His death leaves a void in the ranks of British gas engineers, which can hardly be filled; for few men living unite, as he did, the ripest and most varied experience with high receptivity and a striking originality. Many men have won more exalted positions in the world; but few men will be more sincerely mourned, alike by intimate friends and associates and the wider circle of acquaintances (who in his case comprehend a large proportion of the world of English speaking gas engineers) than John Somerville.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. C. B. STAATS, of Troy, N. Y., has been elected President of the Cooperstown (N. Y.) Illuminating Company, which is in control of the gas and electric lighting interests of that place, vice Mr. Dudley Farlin, whose financial embarrassment was reported some time ago.

MR. RALPH WOODWARD, formerly Assistant Superintendent, at Hartford, Conn., has been appointed Superintendent of the American Gas Company's works at Peru, Ind. He replaces Mr. A. O. Smith, who retired because of ill health.

CONTRACTS keep rolling in on the Berlin Iron Bridge Company, of East Berlin, Conn., the management of which have just secured the contract for a new iron fire proof storehouse for the Pope Manufacturing Company, at Hartford, Conn. The building, which is to be 40 feet wide by 84 feet in length and two stories high, will be used for storing the separate parts of bicycles, as the Pope Company has to carry a very large stock of the different parts of these machines to supply the wants of the numerous users of the "Columbia Safety." The Scranton (Pa.) Traction Company has also placed a contract for the buildings of its new plant with the Berlin folks. The boiler and engine room will be 65 feet wide by 200 feet long, with a machine shop and car shed, 93 feet wide by 225 feet long. The entire plant will be fireproof, of the well-known Berlin construction.

WE understand that the Indianapolis (Ind.) City Council has defeated the ordinance under which it was proposed to tax the gas mains underlying the streets of the city at the rate of 3 cents per running foot. The ordinance was introduced originally by Councilman Costello.

WE are indebted to Mr. F. I. Baker, of Los Angeles, Cal., for the following, from Fresno, Cal., under recent date: "For some time past negotiations have been in progress between the two lighting companies of Fresno, looking to some arrangement which would result in an occasional dividend. These negotiations came to a close last December when a consolidation was effected, the old company absorbing the new. Until a year or so ago the Fresno Gas and Electric Light Company had a monopoly of furnishing the city with light. Complaints of high charges were frequent, but the Company asserted that it was selling the illuminant at as low a rate as it could, considering the high price for fuel. In view of the fact that it was making but little more than running expenses, it justly characterized the complaints as unreasonable. Then an opposition concern, the Edison Electric Light and Power Company, was organized. Nearly all its stockholders were consumers, but while the latter were benefitted, it is said (and there is no doubt of its truth) that it was at the expense of the Company. The old Company had to meet the reduction in the price for light, and also substituted the water gas for the coal gas system. The price of gas was reduced from $4 per 1,000 to $2.50 per 1,000, and very low competitive rates were made for an electric lighting service. In due time the companies both determined that at the existing rates it was impossible for either to make money, and the stockholders occasionally had to submit to an assessment to even things up. This state of affairs was, of course, a very undesirable one, and when the new company not long ago made overtures for an arrangement regarding consolidation, the old company expressed its willingness to meet its rival half way. About the third week in December a stockholders' meeting was called and held, the result being that a new Board of Directors was elected, the membership of which is as follows: Lewis Leach, L. P. Dresler, Fulton G. Berry, Louis Einstein and Leopold Gundelfinger, both Companies having representation. At the organization meeting Dr. Lewis Leach was elected President, and Mr. A. Gutch, Secretary; Mr. D. Decker was appointed Superintendent. Of these Dr. Leach was President of the old Fresno Gas and Electric Light Company, and Mr. Decker was its Superintendent, which goes to show that the old Company is virtually controller of the situation. The financial reports submitted proved that the Edison Electric Light and Power Company had been considerable behind, and that the Fresno Company had barely held its own. It was also pointed out that as consolidation would reduce running expenses considerably, there was a fair prospect that the combined enterprise would earn something for the shareholders. While there will and must undoubtedly be a revision of the selling rate, the Company will furnish light at as reasonable figure as possible. Gas will hereafter be sold at $3 per 1000—equal to a charge of, say, $1.50 per 1000 in towns of like size in New Jersey or New York, and the increase in the charge for an electric lighting service over the

competitive rates recently in vogue, will amount to perhaps 33⅓ per cent."

GENERAL MANAGER Z. T. F. RUNNER, of the Freeport (Ills.) Gas Light and Coke Company, was somewhat disturbed on the evening of December 26th, when the works hands trooped into the Company's office, with an evident expression of seriousness on their faces. The looks of discontentment however, were feigned; for hardly had Mr. Runner knew of their presence when Mr. I. M. Eastman, stepping out from the group, produced from somewhere a handsome gold headed walking stick, and proceeded to tell Mr. Runner what the men and he thought of him. On receiving the gift. Mr. Runner spoke his thanks and satisfaction, and the subsequent proceedings were of interest only to those who took part therein.

WRITING of Mr. Runner and the men under him at Freeport, brings to mind another bit of news indirectly connected with the gas interest of that bustling town. This time it is a marriage, the contracting parties thereto being Miss Grace V. Farwell, a niece of Mr. L. Z. Farwell, President of the Freeport Gas Light and Coke Company, and Mr. Charles Colby, formerly of Freeport, but now of Chicago.

A CORRESPONDENT at Buffalo, writing under date of January 4th, says: "I read your 'note' in this week's JOURNAL in the matter of the sale of the Niagara Falls (N.Y.) Gas Company, and forward you the following from one of our local dailies in further mention of the transfer. 'For some time past there has been an agitation for a better lighting service in the town of Niagara Falls. Several months ago it was stated that the Niagara Falls Gas Company would put in and operate in connection with its gas plant an electric lighting plant, and this rumor is now confirmed by what has transpired recently. It appears that representatives of a big syndicate, H. G. Danforth and H. L. Brewster, of Rochester, have quietly bought from stockholders of the Gas Company, about $40,000 of the stock, which, representing as it does nearly two thirds of the capital, puts control in the hand of the purchasers. Their expressed intention is to put in an electric light plant in conjunction with the gas works; steam instead of water power will be employed. The Gas Company has long held a franchise to operate an electric lighting plant, and it is stated that it will be in working order within a reasonably short time. Captain Benjamin Flagler and the Honorable Walter P. Horne have sold their interest and will probably retire from the Company, but several of the other old shareholders, including Dr. William B. Rice, of Lockport, N. Y., and Major S. M. N. Whitney and Jas. Vedder, are likely to remain.'"

AT the sale of the works and franchises of the Nyack and Warren (N. Y.) Gas Light Company held on December 27, to close out the estate of the late William Voorhis, the property was purchased by Mr. Howard A. Storms. The reported price was $10,250, at which figure Mr. Storms undoubtedly secured a bargain.

THE Danvers Bleacheries, which have manufactured gas on their own premises for a number of years, for the supply of the works, have decided to discontinue the practice and to become customers of the Salem Gas Light Company.

MR. JAMES A. HADLEY, Superintendent of the Meriden (Conn.) Gas Company, has been elected Vice-President of the Connecticut Electric Lighting Association. They picked out a good man for the place.

PROF. C. H. FERNALD and Mr. F. E. Whitman, have resigned from the Board of Directors of the Amherst (Mass.) Gas Company.

THE Johnstown (Pa.) *Tribune*, says that an application will be made on the 19th inst. to the Governor of Pennsylvania for a charter of incorporation for "The Manufacturing Gas Company." The incorporators are Edward E. Robbins, State Senator from Westmoreland County; Commodore R. Miller, of Greensburg; C. B. Hamm, of Greensburg, formerly of Johnstown; and Messrs. C. G. Campbell, John Pendry, Jas. Kimple, of Greensburg. The capital stock is to be $100,000. The purpose of the Company is to erect a gas plant in Johnstown, and supply gas for fuel purposes to the public generally. It is understood that Senator Robbins is listed for $25,000 of the stock, Mr. C. H. Hamm for $10,000, and Mr. Miller for a like amount. The remainder of the stock will be taken by gentlemen who are interested in the enterprise. As soon as a charter is obtained application will be made to the City Council for permission to pipe the streets, and a site will be obtained for the works. This looks to be on the order of a squeeze, for certainly there is not room enough in Johnstown for two gas companies.

THE Montclair (Col.) Electric Light Company has made an assignment for the benefit of its creditors, who, however, are not likely to be greatly enriched thereby; for the assets are returned at $19,280, while the liabilities are stated to be $151,312.62. The assignee is Mr. Theodore Holland.

MR. NATHAN L. JONES has been appointed gas consumption clerk at the Spring Garden office of the Philadelphia Gas Works, and Mr. Albert Forderer, Jr., will act as bill clerk at the same office.

THE Denver (Col.) plant of the New York Safety Car Heating and Lighting Company, which, under the supervision of Mr. Alonzo Furnald, is supplying Pintsch system gas for lighting the passenger coaches of the Denver and Rio Grande, the Union Pacific, the Colorado Midland and the Rock Island Railroad systems, is working very satisfactorily.

ANNOYED beyond endurance by the vexations incident to the management of the municipal electric lighting plant installed there some time ago, the authorities of Carrollton, Ga., have sold the entire outfit to ordinary, everyday capitalists.

JUST before Christmas eve State Inspector Hi man dropped in on the Pittsfield (Mass.) Coal Gas Company for the purpose of determining the candle power of the gas that was being sent out. When the Inspector's task was completed the figures showed a value of 24.4 candles.

THE regular quarterly dividend of 1½ per cent. on the capital stock of the New Bedford (Mass.) Gas and Edison Light Company is payable on and after the 15th inst.

THE syndicate, headed by Senator James McMillan, that recently secured control of the Mutual Gas Light Company, and the Michigan (natural) Gas Company, of Detroit, Mich., has also purchased the Detroit Gas Light Company. This gives McMillan & Co. entire control of the gas supply of the city. It is reported that the price paid was $200 per share—or $2,000,000.

THE Sintz Gas Engine Company has been incorporated at Grand Rapids, Mich., with a capital of $10,000. Its officers are: President and Superintendent, Clark Sintz; Vice President and Secretary, F. D. Hills; Treasurer and Manager, A. A. Barber. The Company's works will be located at what is known as the New England Building, on Canal street.

Some time ago, at a special election of the voters of Hillsdale, Mich., it was determined to install and operate on municipal account an electric lighting plant. Naturally enough, Mr. F. W. Stock, who owns the electric lighting enterprise, was greatly disturbed over the result of the voting. Having gone over the subject matter in a very thorough fashion, Mr. Stock thought it was time he had an innings, and the result is that he has instituted a suit against the authorities for $10,000 damages, basing his claim on the allegation that the election was not legal.

ABOUT a fortnight ago Judge Tuley, of Chicago, decided the suit of Charles A. Street, Trustee of the two sons of the late Charles J. Wyeth, against Sanford B. French and the Chicago Economic Fuel Gas Company, to compel the defendants to purchase some dock property along the South Branch, near 22d street, Chicago, for $50,000. Nathan Corwith was named executor in the will, and to secure the two sons he conveyed the land in question to his brother as trustee. It is said Corwith used the funds of the estate for his own private business and that in 1888 he became financially embarrassed. On a bill filed by the children it was decreed that Corwith owed the estate $89,000, and the dock property was turned over to Street, as Trustee for the indebtedness. Subsequently the proprietors of the Economic Gas Company agreed to purchase the property at a given figure, through its agent, S. B. French, and later on declined to carry out the contract on the ground that Street could not give a good title. Judge Tuley held there was a question whether it could compel Street to give title, and further said that where there was a reasonable doubt a court should not compel a specific performance of a contract. The bill was dismissed and an appeal allowed.

THE Elizabeth (N. J.) City Council has awarded a contract for the public lighting of the streets by gas to the Elizabethtown Gas Company at the rate of $17.50 per lamp per annum, an all night and every night schedule to be followed. The agreement is to last for three years. The

new rate, which is the same as that paid the Consolidated Gas Company of this city, is $4 per lamp per annum over the rate paid on the contract just expired; but the authorities are being very cheaply served, for it should be remembered that when the old contract of $13 per lamp was entered into the striking capitalists who engineered the opposition (or Metropolitan Company, were bidders for the the contract. Now, however, that the Metropolitan Company has been "absorbed," or taken out of the slough of financial despond into which it had fallen, by the kindly act of the Company that weathered the stormy times of the opposition movement, we do not think that the victors could be justly accused of unfair dealing with the authorities did they ask $20 per lamp per annum in the peaceful present days at Elizabeth.

We are in receipt of a handsome vest pocket memorandum book, from Mr. James Gardner, Jr., of Pittsburg, whose fireclay goods for gas works have stood and are prepared to stand the trying tests of heat and time. It is a very convenient pocket furnishing, and we do not doubt that those who receive the Pittsburg man's "remembrancer" will often have occasion to consult its pages.

The Gas Consumers' Association, of San Francisco, which is formed somewhat on the lines of the Gas Appliance Exchange, recommends to the architects of that city, the following: "We hereby respectfully beg to make the following suggestions regarding the piping for gas in modern buildings, in view of the growing demand for gas used for cooking and heating purposes, viz: That two entirely separate lines of pipe be run from the meter—one supplying gas for illuminating and one for heating purposes." The offices of the Association are at No. 323 Sutter street, San Francisco.

Beginning with the 1st inst., the Adrian (Mich.) Gas Company agreed to put its gross selling rate for lighting purposes, at $2 per 1,000 cubic feet, on which a discount of 10 per cent. is to be allowed on all bids paid at the Company's office before 5 o'clock P.M., of the 10th day of the month in which they are rendered. In any instance where a meter shows that no gas had been used in the month a charge of 25 cents will be made. The Company also promises to make a rate "on gas used in cook stoves, heating stoves and engines * * * so that gas will be not only the most convenient but the cheapest fuel in Adrian." This shows that Messrs. Webster and Raynor mean to keep the gas business in Adrian where it always has been—in the front ranks of that city's many enterprises.

The Adrian Company, in announcing the reduction or concession, also distributed throughout the city two circulars that seem to be worth reprinting here. The first of these is as follows:

"*To our Patrons:* During past months (in many cases years) of business relations we have learned our mutual need of each other. You look to us for light to chase away the shades of darkness and lend cheer to the home, comfort to the business house; we look to you for enough of glittering gold to enable us to meet our obligations and get a few of the comforts of life. We have tried to give you good service, and you, in turn, have treated us very kindly, and though accidents have occurred, and bills were sometimes larger than was hoped—and it has been said that 'men may come and men may go, but the meter goes on forever'—yet grievances have been few, the 'hatchet has been buried,' and all forgiven and forgotten. In view of the pleasant past, and in hope of a still better future, we have decided to observe the new year by making a reduction in the price of gas, with the expectation that you will give us increased patronage, and thereby hasten the dawning of that day when we shall 'do so some more.' Thanking you for past courtesies, trusting to merit your future goodwill and favor, we are, truly yours—Adrian Gas Company."

The second circular (which was mailed to non-users of gas) is:

"*To the Proprietor:* We wish to call your attention to gas as a means of lighting. Certainly, no one would dispute its convenience; and at the reduced price we are now asking it is assuredly of reasonable cost. The day is coming when kerosene will be used but little, if any, by our business houses, the trouble and danger attending its use being sure to relegate it to the past. And it is our earnest hope that you will be one of the first to join the ranks of gas consumers, thereby increasing your business facilities and personal comfort, and also giving us the satisfaction of adding one more to our list of customers. If your place of business needs piping and fixtures, we will gladly furnish estimates as to cost, and guarantee first-class work and low prices. Please give the matter your serious consideration, and if there is any information we can furnish do not hesitate to command us. We want to do business with you, and will do everything in our power to make it mutually pleasant and satisfactory.—Adrian Gas Company."

The report that the works of the Albion (N.Y.) Gas Company would be shut down on the 1st inst., was quite unfounded. The works will be operated as usual.

The Gloucester (Mass.) Gas Light Company is enlarging its storage buildings, and the business of the Company is steadily improving.

The following from the Chicago *Post*, of recent date, concisely explains the gas rate situation there. "On January 1, the price of gas to consumers will be 5 cents less per 1,000 cubic feet than has hitherto been charged and the rebates on the city's bills for the lighting of streets and public buildings will be much larger. This is in accordance with a contract entered into in June, 1891, by the gas companies and the city by which the former agreed to reduce the price of gas to consumers 5 cents annually, beginning January 1, 1893, until a maximum price of $1 per 1,000 feet is reached. On December 28, President Billings announced that the gas companies would carry out their agreement and that the net price of gas for the coming year would be $1.20. The bills will be made out as formerly for $1.50 per 1,000 feet but 30 cents instead of 25 cents rebate will be given to the consumer, who pays his bill before the 10th of the month. During the year 1894, the bill will be made out for $1.40, the rebate will be 25 cents, and the reduction in the net price of gas will continue until 1897, when the price will be but $1 per 1,000 feet. Although the gas companies will not receive as large a price for their product they expect to profit by the change, as much more gas will doubtless be consumed. As the city receives 3½ per cent. of the gross receipts of the gas companies' sales the cost of lighting the streets and public buildings will be lessened. The city's gas bill for the year past was $525,000, and it received a rebate of $175,000, making its net bill $350,000. While the city is now paying $14 per year for each street lamp, it will be required to pay but $13 for the coming year. For lighting public buildings the cost is but $1 per 1,000 feet. By the new arrangement the consumers, the city and the gas companies profit considerably."

As said before in the Journal, the St. Paul (Minn.) Gas Light Company is now entirely under the control of local capitalists, who also are in control of the electric lighting interests of the city. Its officers are: President, Mr. Crawford Livingstone; Vice-President, Mr. W. R. Merriam; Genl. Supt., Mr. B. F. Ellisen—the officers are also the Board of Directors. No change in this arrangement is likely to occur until the annual meeting in February, at which time it is presumed the new proprietors will agree on a plan for works betterments and extensions. It would not surprise us at all if, among the betterments, the Company should decide to construct a new purifying house on the model designed by Mr. A. H. Barret for the Louisville (Ky.) works.

Paint as Used on Engineering Constructions.

At a meeting of the Engineers' Club of Philadelphia, Mr. E. Hurst Brown read a paper on the subject named in the heading, in which he described the composition of paints for use on wood and metal surfaces, with particular attention to the proper material to use on structural iron work.

It is very essential that the iron itself should be absolutely free from rust, as the latter will spread from a point under the paint if there be the slightest chance for it to do so, flaking off the paint, and thus gradually exposing the bare surface of the iron to the destructive action of oxygen in the presence of water.

The iron should be prepared by removing the scale with a stiff wire brush and destroying the rust by a pickle of dilute acid, which must be afterwards washed off before applying the paint. For use on iron exposed to changes of temperature, to gases or moisture, a paint was recommended called "anti-rust," which is manufactured especially for this purpose. Sections of iron pipe were shown which had been painted with this material, and with other kinds of paint, and exposed to various severe conditions of temperature and oxidizing gases. The writer considered it very important that specifications for painting engineering constructions should be carefully drawn and strictly adhered to, even to the specification of definite brands or makes of materials. The engineer should experiment in order to determine the best paint to use under given conditions, or should seek advice on the subject from those who have made its manufacture and its wearing qualities the study of their lives. It is poor economy to use any but the best material obtainable, the saving in first cost being more than counterbalanced by the labor of renewing the paint in a comparatively short time.

The Market for Gas Securities.

The market for city gas shares was dull and drooping during the week. Consolidated showed a falling off of full 2½ points, but as the offerings were very light, the decline may be fairly attributed to the vagaries of the bears. To-day (Friday) the stock opened at 124¼ bid. Other city shares show no marked change from the figures of last Friday.

In Brooklyn the situation seems more perplexing than ever. The Equity Company, it is said, having been completely delivered from the presence of its former President, Mr. Devlin, is now asserted to have come under the domination of the parties who are behind the scenes in the famous scheme to manufacture gas on Long Island, to be distributed in New York City, via a tunnel underneath the East river. No doubt the Devlin disentanglement is in its favor, but we are not disposed to look upon the new alliance as an unmixed blessing. In any event, the bare fact is that the Company's securities are showing a hardening tendency, the stock being quoted at 45 bid, while the bonds are bid for at 70, ex January coupon.

Two bids were made last week for two-thirds of the stock in the Metropolitan Company. The first of these was submitted by Mr. Campbell, of the People's Trust Company, who offered $150 per share for the stock, and that offer was followed by another, from Mr. Staples, who likely represents the Addicks coterie, under which $155 per share was bid. If the holders refuse that price they might fairly be charged with incapacity to take care of their estates for it will never be worth that money to themselves as an independent concern. The high price no doubt is offered so that the speculators can club the Fulton-Municipal into line. Those who remember the way in which the Fulton-Municipal used the club itself in days gone by will enjoy the turning of the tables. It is futile to speculate on the situation in Brooklyn just now, for chaos about expresses its present standing. Chicago experienced a sharp drop in the week; Baltimore consolidated was steady, and Mr. Addicks Boston Bay State specialties were quoted at lower prices. The annual meeting of the Consolidated (N. Y.) Gas Company will be held on the 23d inst. The books closed on the 7th, to be reopened on the 24th.

Gas Stocks.

Quotations by Geo. W. Close Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

January 9.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	124¾	125
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	188	192
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	142	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	35	40
Preferred	5,000,000	100	88	91x
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	135	140
Citizens	1,200,000	20	112	113½
" S. F. Bonds	320,000	1000	—	103
Equity Gas Light Co.	2,000,000	100	45	—
Bonds	1,000,000	—	70	75
Fulton Municipal	3,000,000	100	149	151
" Bonds	300,000		102	—
Peoples	1,000,000	10	105	108
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	870,000	100	135	—
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	160	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	150	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Boston United Gas Co.—				
1s Series S.F. Trust	7,000,000	1000	88½	88¾
2d " " "	3,000,000	1000	77½	78
Bay State Gas Co.—				
Stock	5,000,000	50	55	56
Income Bonds	2,000,000	1000	77	78
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	86⅜	86½
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	85	90½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Consumers Gas Light Co., Jersey City	2,000,000	100	20	—
Bonds	600,000	1000	80	—
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	190	191
Central, S. F., Cal			90	—
Capital, Sacramento, Cal			55	—
Consolidated, Balt	11,000,000	100	58¾	59
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
East River Gas Co., Long Island City	1,000,000	100	100	105
Bonds	500,000	100	100	102
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	180	200
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	23¼	23½
Preferred "	2,500,000	100	69½	71
Bonds	9,034,400	1000	85	85¼
Louisville, Ky	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	40	—
" Bonds	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal			40	45
Peoples, Jersey City		—	115	125
" " Bonds			—	—
Paterson, N. J		25	99	102
Rochester, N. Y		50	99	100

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